PATENT SPECIFICATION (11) 1 506 428

1 506 428

(21) Application No. 19068/75 (22) Filed 7 May 1975
(31) Convention Application No. 467 935
(32) Filed 8 May 1974 in
(33) United States of America (US)
(44) Complete Specification published 5 April 1978
(51) INT CL² B65D 75/00; A22C 13/00
(52) Index at acceptance
B8C 12E2 14 24B3 24B5
A2B 19A2 19A3B 19AX

(19)

(54) IMPROVEMENTS IN AND RELATING TO PACKAGES OF TUBULAR MATERIAL

(71) We, UNION CARBIDE CORPORATION, a corporation organised and existing under the laws of the State of New York, United States of America, of 270 Park Avenue, New York, State of New York 10017, United States of America, (assignee of ARTHUR LEE SHERIDAN and WALTER VALENTINE MARBACH), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a package of tubular material.

Flexible tubing material such as flexible plastics, elastomers, paper, fabric and the like heretofore has been provided either in the form of short pieces that can be easily opened and filled as packages or wound in flattened form on suitable spools or cores for storage. When tubular material has been provided in the form of a flattened tube wound on a spool or core, it has been generally used by unwinding from the core and opening and filling in discrete segments.

In the meat packing industry, synthetic sausage casings, which are a specialized type of flexible tubing material, ranging in lengths of from 40 to 160 feet or more, are prepared in a pleated and compressed or shirred form of the order of a few inches in length. The compressed length of tubular casing is filled by being placed on a stuffing horn through which a meat emulsion is extruded to fill the casing to its fully extended length.

The shirring apparatus and processes widely used in the sausage casing art have been generally found most suitable for use with small diameter (i.e., having a diameter of about 12 mm to 40 mm) artificial tubular casing such as used in the production of frankfurters, and particularly casing formed of regenerated cellulose. Cellulosic casings of intermediate or larger size with diameters greater than about 40 mm, either reinforced with fibrous material or not, have greater wall thickness or other characteristics that limit the compacting and interlocking of the pleated tubing walls. As a result, compressed lengths of such pleated tubular casing do not maintain the integrity required to be self-sustaining and the compressed tubes tend to break and the pleats separate.

In one widely used prior art technique to overcome this disadvantage, the compressed length of pleated tubing made from large diameter tubing is provided with a support core, generally in the form of a rigid tube of plastic material, inserted into the bore of the compressed length of pleated tubing immediately after the compression step. Separation of the compressed pleats is prevented by a pin or peg extending transversely through the walls of the support tube at both extremities thereof, restraining the endwise expansion of the compressed tubing.

The core tube and peg arrangement is relatively expensive. Moreover, the arrangement does not permit ready placement on a stuffing horn without additional time-consuming manipulations by the stuffer operator.

Other techniques for maintaining the integrity of a compressed strand of tubular casing have been shown in patent literature and specific reference is made to U.S. Patent Nos. 3,528,825 and 3,639,130.

However, there is still a demand for a method of storing long lengths of tubular material that is simple and economical in both time and material and which permits continuous filling of the tubing. A particularly desirable technique would be one that was suitable for use with a wide variety of different types of tubular materials enabling them to be readily and continuously filled in packaging and the like applications.

In accordance with the present invention, there is provided a self-sustaining length of flexible, thin-walled tubular material comprising a length of pleated and compressed flexible, thin-walled tubular material having a substantially straight bore extending therethrough and an open end and a tubular elastic

sheathing material stretched and tightly drawn about the periphery of said length of compressed tubular material and radially inwardly over at least a portion of each of the terminal pleats at each extremity thereof, said sheathing retaining the compressed, pleated thin-wall tubing in a self-sustaining length thereof.

The invention also includes a method of preparing a self-sustaining length of thin-walled flexible tubular material which comprises providing a length of pleated and longitudinally compressed flexible, thin-walled tubular material mounted about a mandrel, providing a length of tubular elastic sheathing material having an inner diameter smaller than the outer diameter of said compressed tubular material, stretching at least a portion of said tubular sheathing material and positioning the stretched portion thereof about the periphery of the compressed, pleated tubular material with the ends of said sheathing material extending beyond the ends of said compressed tubular material, releasing the stretching forces on said sheathing material and permitting the stretched sheathing material to contract about the periphery of said length of compressed tubular material and radially inwardly over at least a portion of each of the terminal pleats thereof whereby said length of compressed, pleated tubular material is retained within said sheathing material, and removing said sheathed length of pleated and compressed, tubular material from about the supporting mandrel.

In a preferred manner of performing the method, a tubular sheathing material that is longer than the length of compressed pleated tubular material is circumferentially stretched only along a portion of its length and the unstretched portion aids in positioning and locating the stretched portion of the sheathing material about the length of compressed tubular material.

It is important that the sheathing material about the periphery and ends of the compressed tubular material be under sufficient tension to maintain the longitudinal compression on the compressed, pleated tubing and thereby the mechanical integrity required to produce a substantially, self-sustaining length thereof.

An advantageous aspect of the sheathed length of compressed tubular material of the present invention is that a considerable length of thin-walled flexible tubular material is made available in a relatively small package that may be readily handled during storage and shipping without premature separation of the pleats and the configuration thereof lends itself to mounting on various stuffing means for continuous filling of the tubular material without undue further manipulation.

Further, in the case of tubular materials such as cellulosic food casings which require treatment such as soaking in water to improve stuffing characteristics, the soaking operation may be carried out without removing the sheathing material, and the sheathing material will contain the expansion in length of the tubular casing due to increased moisture content, permitting the moistened stick to be easily mounted on various types of stuffing horns.

The invention is described further, by way of example, with reference to the accompanying drawing of a self-sustaining length of pleated and compressed thin-walled, flexible tubular material of the invention.

There is shown in the figure a length 10 of pleated and compressed thin-walled, flexible tubing having a substantially straight bore 11 extending therethrough. The length of compressed thin-walled, flexible tubing 10 is contained within a tubular elastic sheathing material 12 that is stretched and tightly drawn about the periphery of said compressed length of tubular material and radially inwardly over at least a portion of each of the terminal pleats 13 and 14 at the extremities thereof, preferably without restricting admission to the bore therethrough. The ends 15 and 16 of the sheathing material 12 extending beyond the extremities of the compressed tubing 10 are in a relaxed and untensioned state, retaining the terminal pleats of the compressed, pleated tubular material therein thereby retaining the entire length in a compressed state and maintaining the degree of compression on the pleats substantially as originally imposed thereon to form a self-sustaining length thereof.

A wide variety of tubular materials may be employed in the preparation of the self-sustaining length of compressed, pleated tubular material of the present invention.

Suitable tubular material may be any thin-walled, flexible tubing that may be prepared in a continuous length of, for example, 40 or more feet, and that is flexible yet strong enough to withstand rapid folding and a high degree of compression when folded. Typical materials are thin-walled, flexible thermoplastic tubing such as may be prepared from polyethylene and other polyolefins, polyvinylidene chloride, polyvinylchloride, polyesters and the like, and regenerated cellulosic tubing including fibrous web reinforced tubing, such as intermediate and large size tubular fibrous sausage casing.

It has been found that apparatus and processes well known in the food casing art for shirring tubular cellulosic food casing such as, for example, disclosed in U.S. Patent Nos. 2,983,949 and 2,984,574, may be employed in the preparation of the pleated and compressed tubular materials of the present invention wherein compression ratios of approximately 40:1 and up to 100:1 or even greater may be obtained.

Tubular elastic material constituting the

sheathing material of the present invention may be prepared from any one of a wide variety of well known plastics or elastomeric materials which are elastic, i.e. capable of being stretched and then substantially recovering the original size and shape when stress is removed. For example, thermoplastic polymers such as polyvinylchloride, polyvinylidenechloride, polyethylene and other polyolefins formulated to exhibit suitable elastic properties as more extensively discussed hereinafter may be suitable for preparing the sheathing material of the present invention. Also suitable may be elastomeric materials such as natural rubber, polychloroprene, polyurethane, polybutadienestyrene copolymers and the like.

In general, suitable tubular, elastic sheathing material may be seamless or seamed tubing and may be prepared as individual discrete lengths or cut from continuous lengths of tubing. The elastic tubing of this invention should preferably be capable of being uniformly transversely circumferentially expanded at least 75% without tearing or rupturing and should exhibit a "permanent set" not greater than about 10%. Relatively high tensile modulus properties at low elongation, i.e., the stress required to stretch the material 30% to 90%, is also desirable to maintain the mechanical integrity of the compressed length of pleated tubular material and retain the terminal pleats within the sheathing material, yet should not cause distortion of the pleated tubing or the general configuration of the compressed tubing. The elastic sheathing material may be perforated to provide holes about the periphery of the sheathed, compressed, pleated tubing when, for example, it may be desired to provide means for the ready soaking with water of a compressed pleated tubing such as fibrous sausage casing.

The self-sustaining length of compressed pleated tubing of the present invention may be prepared in conjunction with the apparatus used to form the pleated and compressed length of thin-walled, flexible tubing or completely separate therefrom.

A typical method for preparing the self-sustaining length of compressed, pleated tubular material of the present invention may involve supporting a length of compressed, pleated tubing on a mandrel while maintaining a longitudinal compression on the pleated tubing to prevent premature separation thereof. The support mandrel for the compressed tubing may be the mandrel over which the tubing was advanced during the pleating and compaction thereof or may be any suitable support mandrel means about which the compressed, pleated tubing may be arranged having associated therewith means to maintain the desired longitudinal compression on the pleated tubing. While the amount of compression used is not critical, it should be sufficient to purge as much air as possible from within the pleated tubular material to establish the highest possible apparent density within the desired length of compressed, pleated tubular material.

A length of elastic tubular sheathing material having two open ends is then uniformly transversely circumferentially stretched and the stretched sheathing material is positioned about the longitudinally compressed length of pleated tubing with the ends of the tubular sheathing material extending beyond the ends of the compressed tubing. The tubular sheathing material may be uniformly circumferentially stretched using means well known in the art. The ends of the sheathing material extending beyond the ends of the compressed length of tubing contract and are drawn radially inwardly over the terminal pleats at the extremities of the compressed, pleated tubing whereby the entire length of said pleated tubing is retained within the tubular sheathing material. The sheathed compressed, pleated tubing may then be removed from about the supporting mandrel.

It is essential that the elastic tubular sheathing material be long enough or can be stretched to contain the compressed length of tubing to be retained and, further, that the unstretched diameter of the elastic tubular sheathing is smaller than the outer diameter of the compressed, pleated tubing. It is also generally preferred that the unstretched diameter of the tubular sheathing material be large enough so that it will not restrict admission to the bore of the compressed, pleated tubing retained therein.

In general, the original unstretched diameter of the tubular sheathing material should be at least about 10% and preferably about 20% smaller than the outer diameter of the compressed, pleated tubing to be sheathed. Tubular sheathing prepared from suitable elastic materials as herein described, that exhibits "permanent set" properties less than about 10% after being stretched from about 30% to 90%, should, therefore, recover after being stretched, by an amount sufficient so that the ends thereof extending beyond the extremities of the compressed, pleated tubing are drawn radially inwardly over the terminal pleats of the compressed tubing to retain the entire length thereof within the sheathing material. It will be apparent to those skilled in the art that the diameter of the elastic tubular sheathing material actually required to retain a compressed length of pleated tubular material will depend on the type of pleated tubing that is to be retained and the degree of compression required to maintain the mechanical integrity or desired length thereof.

In another method embodying the invention, a compressed, pleated tubing supported on a mandrel is maintained under longitudinal compression to maintain its desired length. A tubular sheathing material, as herein des-

cribed, that is longer than the compressed tubing to be sheathed is uniformly, transversely circumferentially stretched over a portion of its length and the compressed, pleated tubing is inserted into the stretched sheathing material until contacting the portion of sheathing material that has not been stretched. The means employed for inserting the compressed tubing into the stretched sheathing material may also be used to exert a final longitudinal compression on the compressed tubing before or after withdrawing the stretching forces from the sheathing material. The stretching forces may then be withdrawn from the sheathing material, permitting the stretched portion thereof to contract about the compressed length of pleated tubing to retain it therein. The sheathed, compressed length of pleated tubing, when removed from about the supporting mandrel, is self-sustaining and maintains its integrity during handling thereof.

Thus a self-sustaining length of compressed, pleated tubular material can be prepared wherein a long continuous length of thin-walled, flexible tubing is provided in a substantially shorter length than may be readily handled during storage and shipping and may be continuously filled using automatic stuffing equipment.

Elastic tubular sheathing materials suitable for use in accordance with the practice of the invention are, in general, capable of being stretched longitudinally as they are stretched circumferentially. In another embodiment of the method of the present invention, there is prepared a length of compressed pleated tubular material supported on a mandrel and maintained under longitudinal compression to a predetermined length. An elastic tubular sheathing material, as herein described, is provided of a length equal to or shorter than a desired predetermined length of compressed pleated tubular material. Said elastic material is uniformly, transversely circumferentially stretched over a portion of its length by stretching means, and a first end of the compressed pleated tubing is inserted into the stretched sheathing material until contacting a first end portion of sheathing material that has not been stretched. A final longitudinal compression is exerted on the compressed, pleated tubing to progressively remove the sheath from the stretching means, and longitudinally stretch the sheathing material until the second end thereof extends beyond the second end of said compressed tubing to provide an amount of sheathing material sufficient to contract down about at least a portion of the terminal pleats of the compressed length of pleated tubing and retain it therein.

The invention is described further, by way of example with reference to the following examples.

Example 1.

Food casing "shirring apparatus" as disclosed in U.S. Patent Nos. 2,983,949 and 2,984,574 was employed in this example.

A 27.5 metre length of thin-walled, flexible tubular material prepared from polyvinylidene chloride polymer resin was advanced about a hollow "shirring" mandrel through the "shirring passage" of a "shirring machine" and the pleated tubular material was longitudinally compressed on the mandrel to a length of about 26 cm. The tubing employed had a flat width of about 19.7 cm. and a wall thickness about 0.056 mm.

Using the stretching apparatus disclosed in U.S. Patent 2,884,328, a 46 cm. long segment of an elastic, flexible, tubular material prepared from polyvinylchloride resin commercially available under the trademark "VISTEN" was transversely circumferentially stretched about 40% over a substantial portion of its length and the stretched tubing was positioned over he compressed length of pleated tubing with the ends thereof extending beyond the ends of the compressed tubing. The elastic tubing had a flat width of about 14 cm. and a wall thickness of about 0.046 mm.

The stretching device was removed from the tubular elastic material and the elastic tubing contracted about the compressed length of pleated tubing totally retaining the pleated tubing therein.

Five more 27.5 metre length samples of the thin-walled polyvinylidene chloride tubular material of this example were pleated, compressed and then sheathed as described above.

The six samples of sheathed, compressed, pleated tubular material were measured and found to range in length from about 33 cm. to 39.4 cm. The internal or bore diameter of the sheathed tubular material ranged from 5.1 cm. to 5.7 cm. and the external diameter from 13.6 cm. to 14.6 cm. After removal from the "shirring" mandrel, each of the lengths of sheathed, compressed, pleated tubular material was self-sustaining and no premature separation of the pleats occurred during handling. The internal bore through the compressed, pleated tubing was substantially straight and unrestricted. Water pressure testing of the pleated tubular material showed that no rupturing or formation of pin-holes resulted from the pleating and compression operations.

Example 2.

The apparatus and procedures of Example 1 were used for processing 23 metre lengths of various types of thin-walled, flexible tubular materials into pleated and compressed lengths thereof about a "shirring" mandrel. The compression force used to longitudinally compress the pleated tubing about the mandrel was the same for all the samples.

The elastic tubular sheathing material of Example 1 was used in this example. Four different diameter tubular sheathing materials were used with each of the various samples of compressed, pleated tubing of this example and the procedure of Example 1 was used to sheath the compressed, pleated tubing samples of this example.

The types of thin-walled, flexible tubular material used to form the compressed, pleated tubing and various characteristics of the sheathed, compressed lengths formed therefrom are summarized in Table I below.

Each of the samples of the example was self-sustaining, had an unrestricted bore and exhibited no premature separation of the compressed pleats during handling. Deflection of the Sample L sheathed tubing may be greater than desired for ready installation on a stuffing means but would not be totally unsuitable.

TABLE I

Sample	Thin Walled Flexible Tubing	Diameter Tubing	Wall Thickness	Diameter Sheathing Material	Diameter Compressed Tubing	Length Compressed Tubing	Stretch of Sheathing Material (%)	Deflection* of Sheathed Tubing
		(mm.)	(mm.)	(mm.)	(mm.)	(mm.)		(mm.)
A	Fibrous Cellulosic Casing	99.1	.097	75.7	108.7	312.7	44%	4.8
B	,,	,,	,,	82.8	108.7	309.6	31%	6.3
C	,,	,,	,,	89.9	109.5	327.0	22%	12.7
D	,,	,,	,,	96.0	112.7	327.0	17%	15.9
E	Polyvinylidene Tubing	100.1	.056	75.7	107.9	330.2	43%	19.0
F	,,	,,	,,	82.8	109.5	336.5	32%	19.0
G	,,	,,	,,	89.9	109.5	352.4	22%	22.2
H	,,	,,	,,	96.0	111.1	361.9	16%	22.2
I	Polyvinylchloride Tubing	96.0	.038	75.7	104.0	238.1	37%	25.4
J	,,	,,	,,	82.8	104.8	222.2	27%	25.4
K	,,	,,	,,	89.9	104.8	238.1	17%	25.4
L	,,	,,	,,	96.0	104.8	247.6	9%	88.9
M	Polyethylene	98.0	.051	75.7	111.1	308.0	47%	17.5
N	,,	,,	,,	82.8	109.5	336.5	32%	17.5
O	,,	,,	,,	89.9	107.9	377.8	20%	22.2
P	,,	,,	,,	96.0	107.1	409.6	12%	44.4

* Deflection of sheathed compressed tubing due to its own weight.

Example 3.

Using the apparatus and procedures of Example 1, 23 metre lengths of a 15.5 cm. flat width (9.9 cm diameter) tubular fibrous food casing having a moisture content of about 14% were pleated and compressed and then sheathed with the elastic tubular sheathing material of Example 1. Several diameters of sheathing material were used. The sheathed, self-sustaining lengths of compressed tubular material were immersed in water for various periods of time and the effects of water immersion are summarized in Table II below.

Each of the samples prepared was a self-sustaining length of the compressed fibrous tubular casing that exhibited no premature separation of the pleated tubing during handling thereof. After the water immersion tests, each sample of sheathed tubing maintained its self-sustaining characteristics and in no instance did any of the pleated casing exude from within the sheathing material. Further, the sheathed lengths of pleated tubular casing could be mounted on the stuffing horn of a food stuffing machine and continuously stuffed without the need for removing the sheathing material prior to stuffing.

TABLE II

		Soaking Time in Water									
				5 Minutes				60 Minutes			
		Sheathed Tubing		Sheathed Tubing				Sheathed Tubing			
Sample	Sheathing Material Diameter	Length	Outer Diameter	Length	% Change	Outer Diameter	% Change	Length	% Change	Outer Diameter	% Change
	(mm.)	(mm.)	(mm.)	(mm.)		(mm.)		(mm.)		(mm.)	
A	75.7	311.1	109.5	336.5	+8	109.5	0	368.3	+18	107.9	−1
B	82.8	339.7	111.1	349.2	+3	112.7	+1	406.4	+20	112.7	+1
C	89.9	336.5	111.1	393.7	+17	112.7	+1	492.1	+46	111.1	0
D	96.0	342.9	111.1	406.4	+19	111.1	0	482.6	+41	111.1	0

Example 4.

Using the apparatus and procedures of Example 1, three 23 metre long samples of the thin-walled, flexible tubular material of Example 1 of three different diameters are pleated and compressed and then sheathed with the elastic tubular sheathing material of Example 1.

Characteristics of the self-sustaining lengths of compressed tubular material are summarized in Table III.

TABLE III

Sample	Compressed, Pleated Tubing		Sheathing Material				
	Outer Diameter	Bore Diameter	Unstretched Diameter	Stretched Diameter For Sheathing		Stretched Diameter About Compressed Tube	
	(cm.)	(cm.)	(cm.)	(cm.)	% stretch	(cm.)	% stretch
A	3.8	2.54	2.54	4.13	63	3.8	50
B	7.6	5.06	5.08	7.94	56	7.7	50
C	15.2	11.4	11.43	15.56	36	15.2	33

WHAT WE CLAIM IS:—

1. A self-sustaining length of thin-walled flexible tubular material comprising in combination:

(a) a length of pleated and longitudinally compressed thin-walled flexible tubular material having a substantially straight bore therethrough and an open end; and

(b) a tubular elastic sheathing material stretched and tightly drawn about the periphery and radially inwardly over at least a portion of each of the terminal pleats at the extremities of said length of compressed and pleated tubular material, thus retaining said pleated tubular material therein whereby a self-sustaining length of said thin-walled flexible tubular material is formed.

2. A self-sustaining length of tubular material as claimed in claim 1 wherein said elastic tubular sheathing material does not restrict admission to the bore through the compressed tubular material sheathed therein.

3. A self-sustaining length of tubular material as claimed in claim 1 or 2 wherein the elastic tubular sheathing material is stretched circumferentially by at least about 10% when fitted over the compressed, pleated tubular material.

4. A self-sustaining length of tubular material as claimed in claim 1, 2 or 3 wherein said elastic tubular sheathing material exhibits "permanent set" properties not greater than about 10% after being stretched circumferentially between about 30% and 90%.

5. A self-sustaining length of tubular material as claimed in claim 1, 2, 3 or 4 wherein said thin-walled flexible tubular material comprises a thin-walled, flexible, thermoplastic tubing.

6. A self-sustaining length of tubular

material as claimed in claim 1, 2, 3 or 4 wherein said compressed length of thin-walled, flexible tubular material comprises a tubular fibrous food casing.

7. A self-sustaining length of thin-walled flexible tubular material as claimed in any preceding claim in which the sheathing material is maintained under sufficient tension to retain the compression of said length of tubular material.

8. A method of preparing a self-sustaining length of thin-walled, flexible tubular material comprising:

(a) providing a length of longitudinally compressed pleated thin-walled flexible tubular material mounted about a mandrel support;

(b) providing a length of tubular elastic sheathing material having an inner diameter smaller than the outer diameter of said compressed tubular material;

(c) stretching at least a portion of said sheathing material and positioning the stretched portion thereof about the periphery of the compressed, pleated tubular material with the ends thereof extending beyond the ends of said compressed tubular material;

(d) releasing the stretching forces on said elastic sheathing material and permitting the same to contract about the periphery and radially inwardly over a least a portion of each of the terminal pleats of said compressed tubular material so that the total length of compressed pleated tubular material is retained therein; and

(e) removing said sheathed length of pleated tubular material from about the mandrel support whereby a self-sustaining length of thin-walled, flexible tubular material is formed.

9. A method as claimed in claim 8 wherein the inner diameter of the tubular elastic sheathing material is at least about 10% smaller than the outer diameter of the compressed length of pleated tubular material.

10. A method as claimed in claim 8 or 9 wherein a portion of the tubular elastic sheathing material is uniformly transversely circumferentially stretched and the unstretched portion thereof is used to position the stretched portion about the compressed length of tubular material.

11. A method as claimed in claim 8, 9 or 10 wherein the tubular elastic sheathing material is circumferentially stretched between about 30% and 90% before positioning about the compressed pleated tubing.

12. A method as claimed in claim 8, 9, 10 or 11 wherein the compressed length of pleated tubular material is inserted into the stretched portion of elastic sheathing material.

13. A method as claimed in claim 8, 9, 10, 11 or 12 wherein the length of tubular elastic sheathing material is longer than the length of compressed pleated tubular material.

14. A self-sustaining length of thin-walled flexible tubular material constructed substantially as herein particularly described with reference to and as illustrated in the accompanying drawing.

15. A method of preparing a self-sustaining length of thin-walled, flexible tubular material substantially as herein described with reference to the accompanying drawing.

16. A method of preparing a self-sustaining length of thin-walled, flexible tubular material substantially as herein described in any of the examples.

W. P. THOMPSON & CO.,
Coopers Buildings,
12 Church Street,
Liverpool L1 3AB.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1506428 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*